UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

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MEMORANDUM

SUBJECT: Review of Endosulfan Incident Reports
DP Barcode D261701, Chemical #079401

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BACKGROUND

The following data bases have been consulted for the poisoning incident data on the active ingredient Endosulfan (PC Code:079401):

1) OPP Incident Data System (IDS) - reports of incidents from various sources, including registrants, other federal and state health and environmental agencies and individual consumers, submitted to OPP since 1992. Reports submitted to the Incident Data System represent anecdotal reports or allegations only, unless otherwise stated. Typically no conclusions can be drawn implicating the pesticide as a cause of any of the reported health effects. Nevertheless, sometimes with enough cases and/or enough documentation risk mitigation measures may be suggested.

2) Poison Control Centers - as the result of a data purchase by EPA, OPP received Poison Control Center data covering the years 1993 through 1996 for all pesticides. Most of the national Poison Control Centers (PCCs) participate in a national data collection system, the Toxic

Exposure Surveillance System which obtains data from about 65-70 centers at hospitals and universities. PCCs provide telephone consultation for individuals and health care providers on suspected poisonings, involving drugs, household products, pesticides, etc.

3) California Department of Pesticide Regulation - California has collected uniform data on suspected pesticide poisonings since 1982. Physicians are required, by statute, to report to their local health officer all occurrences of illness suspected of being related to exposure to pesticides. The majority of the incidents involve workers. Information on exposure (worker activity), type of illness (systemic, eye, skin, eye/skin and respiratory), likelihood of a causal relationship, and number of days off work and in the hospital are provided.

4) National Pesticide Telecommunications Network (NPTN) - NPTN is a toll-free information service supported by OPP. A ranking of the top 200 active ingredients for which telephone calls were received during calendar years 1984-1991, inclusive has been prepared. The total number of calls was tabulated for the categories human incidents, animal incidents, calls for information, and others.

ENDOSULFAN REVIEW

I. Incident Data System

Please note that the following cases from the IDS do not have documentation confirming exposure or health effects unless otherwise noted.

Incident#256-12

A pesticide incident occurred in 1992, when a man sprayed endosulfan and experienced malaise three days later. He was seen in the emergency room. Specific symptoms were not mentioned. No further information on the disposition of the case was reported.

Incident#256-13

A pesticide incident occurred in 1992, when a man sprayed endosulfan and experienced respiratory difficulty and diarrhea and was treated by a doctor. No further information on the disposition of the case was reported.

Incident#256-28

A pesticide incident occurred in 1992, when several field workers were seen at a hospital, who did not follow the label, applied endosulfan with back pack sprayers and became ill. No further information on the disposition of the case was reported.

Incident#444-10

A pesticide incident occurred in 1993, when an eight year old boy who may have eaten greens too soon after they were treated with endosulfan. He experienced seizures and jaundice

after treatment at the hospital. Unclear whether this incident is related to pesticide exposure. No further information on the disposition of the case was reported.

Incident#582-3

A pesticide incident occurred in 1993, when a worker treated a greenhouse with endosulfan and four days later became ill. No further information on the disposition of the case was reported.

Incident#582-63

A pesticide incident occurred in 1993, when a man in his truck was accidentally sprayed by an applicator. Several days later he was not feeling well. No further information on the disposition of the case was reported.

Incident#707-20

A pesticide incident occurred in 1993, when a grower applied endosulfan which got into his eyes. No symptoms were mentioned at the time of the call. No further information on the disposition of the case was reported.

Incident#707-23

A pesticide incident occurred in 1993, when a field worker, who was wearing short pants and a short sleeve shirt, entered a tobacco field several hours after a light rain. The plants in the field were not totally dry and the worker began to feel ill. No further information on the disposition of the case was reported.

Incident# 707-37

A pesticide incident occurred in 1993, when a grower, who was not wearing personal protective equipment and did not read the label, applied endosulfan the entire day in his shirt that was soaked with the chemical. He experienced illness (symptoms not reported) and was treated at a hospital. No further information on the disposition of the case was reported.

Incident#844-21

A pesticide incident occurred in 1993, when a man sprayed his garden with endosulfan which spilled onto his clothing. He did not wash or change his clothing and two days later experienced dermatitis. He was treated by a physician. No further information on the disposition of the case was reported.

Incident#995-1

A pesticide incident occurred in 1993, when a boy ingested two cups (at least one pound) of cooked mustard greens that were contaminated with endosulfan (170 mg/kg) and about four hours later experienced a seizure with fixed, dilated pupils with extreme muscle rigidity and was non-responsive. Dr. Wagner, EPA's consultant physician, estimated the dose which 27 kg boy received to be 3 mg/kg (total dose 85 mg). He was hospitalized and later experienced difficulty concentrating and maintaining his attention span. There were also behavioral changes that necessitated parent/teacher conferences. His grades in school showed a marked decline. Dr.

Wagner concluded "I believe that the correlation can be made and that based upon this type of dose and the expected response, the seizures which occurred in your son in January 1993 were the direct result of his ingestion of the contaminated mustard greens." He went on to say that he thought the likelihood of his having chronic brain damage is slight, but did recommend further testing by a psychologist. No further information on the disposition of the case was reported.

Incident#995-2

A pesticide incident occurred in 1993, when an adult ingested cooked mustard greens that were contaminated with endosulfan. This case relates to the contamination incident described above. Specific symptoms were not mentioned. No further information on the disposition of the case was reported.

Incident#1028-1

A pesticide incident occurred in 1994, when an individual, who was not wearing personal protective equipment, cleaned up a spill in a warehouse and became ill. No further information on the disposition of the case was reported.

Incident#1028-8

A pesticide incident occurred in 1994, when an applicator, who was not wearing personal protective equipment, applied the product and experienced skin reactions. No further information on the disposition of the case was reported.

Incident#1028-27

A pesticide incident occurred in 1994, when a woman, who is an asthmatic, rode in a car with her family with a spilled container of the product. She became ill. No further information on the disposition of the case was reported.

Incident#1280-23

A pesticide incident occurred in 1994, when a worker applied endosulfan which got into his eyes. The worker was treated by a doctor. No further information on the disposition of the case was reported.

Incident#1280-28

A pesticide incident occurred in 1994, when a worker applied endosulfan which got into his eyes. No further information on the disposition of the case was reported.

Incident#1280-45

A pesticide incident occurred in 1994, when an applicator drove through a spray cloud on a windy day and became ill several hours later. No further information on the disposition of the case was reported.

Incident#2443-5

A pesticide incident occurred in 1995, when an applicator spilled concentrate on his skin and experienced nausea and skin tingling. No further information on the disposition of the case was reported.

Incident#2443-55

A pesticide incident occurred in 1995, when the wind blew undiluted endosulfan into a worker's face during a spray operation and he became ill. No further information on the disposition of the case was reported.

Incident#3037-94

A pesticide incident occurred in 1993, when an individual was exposed to endosulfan residues in their home. Specific symptoms, if any, were not mentioned. No further information on the disposition of the case was reported.

Incident#3296-12

A pesticide incident occurred in 1995, when an applicator was spraying the product and his hose broke and his clothes were soaked. He immediately showered and changed clothes. He only experienced burning eyes. No further information of the disposition of the case was reported.

Incident#3296-37

A pesticide incident occurred in 1995, when several workers, who were not wearing personal protective equipment, handled the product and two of the workers got endosulfan on their hands and arms. One worker experienced nausea and was taken to the doctor. The other worker experienced swelling of the hands several days later. No further information on the disposition of the case was reported.

Incident#3296-53

A pesticide incident occurred in 1995, when an individual applied endosulfan as a dust, which is not an application on the product's label and became ill for 3 days. No further information on the disposition of the case was reported.

Incident#3582-19

A pesticide incident occurred in 1996, when a child was exposed to the product which was applied to a pecan grove. Specific symptoms were not mentioned but the child was seen by a doctor. No further information on the disposition of the case was reported.

Incident#3582-20

A pesticide incident occurred in 1996, when an individual was working in a greenhouse (not in the area) that was sprayed with endosulfan. A week later the worker experienced flu-like symptoms. No further information on the disposition of the case was reported.

Incident#3582-58

A pesticide incident occurred in 1996, when a home owner sprayed the fireplace with undiluted endosulfan, which is not an application on the product's label. The occupants in the home became ill. No further information on the disposition of the case was reported.

Incident#3599-1

Thirty-two State Lead Agencies responded to a survey of spray drift incidents occurring in 1993, 1994, and 1995. Endosulfan was reportedly involved in 4 such incidents.

Incident#3774-30

A pesticide incident occurred in 1996, when a worker mixed endosulfan with a leaky respirator and four hours later experienced dizziness, nausea, and chest tightness. No further information on the disposition of the case was reported.

Incident#4439-4

A pesticide incident occurred in 1996, when workers unloaded a truck and became ill. No further information on the disposition of the case was reported.

Incident#4439-47

A pesticide incident occurred in 1996, when an applicator sprayed the product for several days and experienced nausea, sweating, and soreness. No further information on the disposition of the case was reported.

Incident#4439-70

A pesticide incident occurred in 1996, when an older man entered a treated field 24 hours later and experienced chills and dizziness five days later. Unlikely that symptoms would have taken 4-5 days to appear. No further information on the disposition of the case was reported.

Incident#4439-101

A pesticide incident occurred in 1996, when a man sprayed endosulfan for several days and experienced nausea, sweating, and soreness. No further information on the disposition of the case was reported.

Incident#4439-127

A pesticide incident occurred in 1996, when a neighboring field was treated with endosulfan that drifted onto a woman in her yard. She experienced skin and eye burning. No further information on the disposition of the case was reported.

Incident#7018-1

A pesticide incident occurred in 1995, when a woman drank from a milk jug that had illegally been prepared with endosulfan (level not reported). The 73 year old woman died after lapsing into a coma. No further information on the disposition of the case was reported.

Incident#7545-3

A pesticide incident occurred in 1998, when an individual spilled undiluted endosulfan onto his body and experienced burning of the skin. No further information on the disposition of the case was reported.

Incident#7545-9

A pesticide incident occurred in 1998, when several workers opened bags of the product which blew onto them. Specific symptoms were not reported at the time of the call. No further information on the disposition of the case was reported.

Incident#7545-36

A pesticide incident occurred in 1998, when a worker was dermally exposed to endosulfan and experienced itching. No further information on the disposition of the case was reported.

Incident#7545-49

A pesticide incident occurred in 1998, when children rode in a van with a spilled container of the product. Specific symptoms were not mentioned, but the children were taken to the hospital for treatment. No further information on the disposition of the case was reported.

Incident#7546-103

A pesticide incident occurred in 1997, when an individual, who applied the product in a short sleeved shirt and without gloves, experienced dizziness, vomiting, and irritated hands twenty-four hours later. No further information on the disposition of the case was reported.

II. Poison Control Center Data - 1993 through 1996

Results for the years 1993 through 1996 are presented below for occupational cases, non-occupational involving adults and older children, and for children under age six. Table 1 reports the numbers of endosulfan cases on which percentages were based. Table 2 presents the hazard information for non-occupational cases involving adults and older children (six years and older) for endosulfan compared with all other pesticides on six measures: percent with symptoms, percent with moderate, major, or fatal outcome, percent with major or fatal outcome, percent of exposed cases seen in a health care facility, and percent hospitalized and percent seen in a critical care facility. The number of occupational cases and cases among children less than six years old was too few to warrant more detailed analysis for these two subgroups.

Table 1. Number of endosulfan exposures reported to Poison Control Centers participating in TESS and number of cases for which medical outcome was determined by age group and occupational category.

Age group and occupational category	Number of exposures	Number with medical outcome determined
Adults and older children (6-19 years), occupational exposure	41	23
Adults and older children (6-19 years), non-occupational exposure	101	46
Children under 6 years old	24	15

Table 2. Comparison between endosulfan and all pesticides for percent cases with symptomatic outcome (SYM), moderate or more severe outcome (MOD), life-threatening or fatal outcome (LIFE-TH), seen in a health care facility (HCF), hospitalized (HOSP), or seen in an intensive care unit (ICU) reported to Poison Control Centers, 1993-1996 for non-occupational cases involving adults and older children.

Pesticide	SYM*	MOD*	LIFE-TH*	HCF*	HOSP*	ICU*
Endosulfan	65.2%	17.4%	2.17%	31.6%	25.0%	18.75%
All Pesticides	70.8%	10.8%	0.34%	18.7%	7.62%	3.36%

* Symptomatic cases based on those cases with a minor, moderate, major, or fatal medical outcome. Denominator for SYM, MOD, and LIFE-TH is the total cases where medical outcome was determined. Denominator for HCF is all exposures. Denominator for HOSP and ICU is all cases seen in a health care facility.

Except for the percent cases with symptoms, endosulfan exhibited a higher percentage hazard for the other five measures. Endosulfan cases were nearly twice as likely to have a moderate outcome and be seen in a health care facility as other cases. The percentage for life-threatening cases was quite high but based on only a single case. Of the 8 cases hospitalized, 6 were seen in the intensive care unit.

Among 41 occupational exposures, there was not a single case that was life-threatening, hospitalized or seen in the intensive care unit. Similar low risks were suggested for children under age six, but only 24 exposures were reported in this group.

III. California Data - 1982 through 1996

Detailed descriptions of 187 cases submitted to the California Pesticide Illness Surveillance Program (1982-1996) were reviewed. In 32 of these cases, endosulfan was used alone and was judged to be responsible for the health effects. Only cases with a definite, probable or possible relationship were reviewed. Table 3 presents the types of illnesses reported by year. Table 4 gives the total number of workers that took time off work as a result of their illness and how many were hospitalized and for how long.

Table 3. Cases Due to Endosulfan Exposure in California Reported by Type of Illness and Year, 1982-1996

Year	Illness Type					
	Systemic[b]	Eye	Skin	Respiratory	Combination[c]	Total
1982	-	-	2	-	-	2
1983	-	-	-	-	-	-
1984	-	-	-	-	-	-
1985	2	-	5	-	-	7
1986	-	-	1	-	-	1
1987	-	-	1	-	-	1
1988	6	-	1	-	-	7
1989	1	1	1	-	-	3
1990	3	-	1	-	-	4
1991	1	-	1	-	-	2
1992	-	-	-	-	1	1
1993	2	-	-	-	-	2
1994	-	-	1	-	-	1
1995	-	-	-	-	-	-
1996	1	-	-	-	-	1
Total	16	1	14	-	1	32

[b] Category includes cases where skin, eye, or respiratory effects were also reported

[c] Category includes combined irritative effects to eye, skin, and respiratory system

Table 4. Number of Persons Disabled (taking time off work) or Hospitalized for Indicated Number of Days After Endosulfan Exposure in California, 1982-1996.

	Number of Persons Disabled	Number of Persons Hospitalized
One day	2	-
Two days	2	-
3-5 days	2	-
6-10 days	-	-
more than 10 days	-	-
Unknown	9	-

A total of 16 persons had systemic illnesses or 50% of 32 persons. Another 44% of the cases experienced skin injury or illness. Endosulfan ranked 61st as a cause of systemic poisoning in California. A variety of worker activities were associated with exposure to endosulfan as illustrated in Table 5 below.

Table 5. Illnesses by Activity Categories for Endosulfan Exposure in California, 1982-1996

Activity Category	Illness Category					
	Systemic	Eye	Skin	Respiratory	Combination	Total
Applicator	5	-	-	-	-	5
Mixer/loader	2	1	-	-	1	4
Manuf./Formulator	-	-	2	-	-	2
Drift exposure	1	-	-	-	-	1
Field residue	7	-	12	-	-	19
Other residue	1	-	-	-	-	1
Total	16	1	14	-	1	32

According to the above activity categories, exposure to field residues was associated with the majority of the exposures and most of these illnesses included symptoms of rashes on exposed body areas such as neck, arms, chest, and face, swelling, dermatitis, and chemical burns to the

hands. However, 37% of workers exposed to field residue experienced systemic poisoning symptoms. Handlers, applicators and mixer/loaders, were more likely to experience systemic symptoms including headache, dizziness, weakness, nausea, vomiting, stomach cramps, and facial paresthesia.

IV. National Pesticide Telecommunications Network

On the list of the top 200 chemicals for which NPTN received calls from 1984-1991 inclusively, endosulfan was ranked 65th with 53 incidents in humans reported and 20 incidents in animals (mostly pets).

V. Literature Review

Boereboom et al. (1998) reported on a forty-three year old man, who was admitted to the hospital, after ingesting 100 ml of endosulfan (containing 18.8 grams of endosulfan, 260 mg/kg body weight) in a suicide. A short time later, he experienced excessive perspiration and salivation, hyperventilation, and seizures. The patient was put on a mechanical ventilator and two days later experienced cerebral herniation. He died four days later after withdrawal of the supportive care.

Grimmett et al. (1996) reported on a twenty-eight year old woman, who was admitted to the hospital, after she injected 1 ml of endosulfan into her body. She experienced seizures fifteen minutes later and has a past history of epilepsy. Three hours later, she experienced tachycardia and hypertension for three days. She was discharged from the hospital twenty-one days later. Two weeks later, she was fully mobile and showed resolved proximal myopathy.

Lo et al. (1995) reported on a seventy-two year old farmer, who was admitted to the hospital, after intentionally ingesting endosulfan. On admission, he was febrile and experienced tachycardia, muscle fasciculations, and convulsions. He regained consciousness two hours later and was discharged to the medical ward. He later developed renal failure and experienced cardiac-respiratory arrest and died ten days later.

Shemesh et al. (1988) reported on a twenty year old man, who was admitted to the hospital, about an hour after intentionally ingesting 200 ml of endosulfan. He experienced unconsciousness, convulsions, cyanosis, diaphoresis, hypotension, and oliguria. He was hospitalized for at least two weeks. A month later the man began to obey simple verbal commands by moving his eyes and a year later his mental state is still severely impaired and he requires medication to prevent seizures.

Bernardelli and Gennari (1987) reported on a fifty-five year old woman, who had malignant melanoma for two years, and was found dead in her bed by her husband. An empty

bottle of 100 ml of endosulfan was found on a shelf near the bed which was purchased the week before her death. The woman left a suicide note.

Aleksandrowicz et al. (1979) reported on a fifty-one year old industrial worker who was admitted to the hospital two years earlier. He drank about ½ to 1 liter of wine per week (according to his family) and was a construction foreman before he worked at a chemical plant where he was responsible for cleaning vats containing residues of endosulfan solution. Four months later, he was admitted to the hospital after experiencing malaise and several fainting spells. He experienced three consecutive convulsions and was put on medication to prevent further seizures. He was released from the hospital three days later. At home, he was agitated and abusive toward relatives and was referred for psychiatric evaluation. The patient was unable to converse except to answer simple questions and exhibited gross cognitive defect, being unable to perform any activities beyond being able to bath, dress and feed himself. Two years later, he still exhibited limited cognition, gross memory defect, and partial nominal aphasia. The Bender Visual-Motor Gestalt Test showed "severe impairment of visual-motor coordination, characteristic of diffuse brain damage". It was reported that he may have experienced heavy exposure to endosulfan while cleaning the vats and did not seem to follow standard precautions.

Demeter et al. (1977) reported on a twenty-eight year old who sprinkled rose bushes with endosulfan. According to his mother, the next day he went out and came back in the house late in the night intoxicated. A short time later, the mother found her son on the bedroom floor severely ill and trying to vomit. He was rushed to the hospital and was dead on arrival. The autopsy revealed strong findings of an asphyxial death due to poisoning. The authors concluded that the cause of death was due to ingestion of endosulfan but alcohol may have been a contributing factor.

Sood et al. (1994) reported on a twenty-four year old male, who was admitted to the hospital after accidentally ingesting 20 ml of endosulfan. A half an hour later, he experienced restlessness, giddiness, nausea, vomiting, and unconsciousness. Two hours later he experienced tonic clonic seizures and two days later experienced apnea and hyperpnea. He was conscious three days later and made a full recovery.

Pradhan et al. (1997) reported on a sixteen year old girl who attempted to commit suicide by consuming about 75 ml of endosulfan. Within the next hour she experienced nausea, headache, giddiness, and vomiting. Within two hours, she experienced seizures for the next four hours. She remained unconscious for 36 hours. After she regained consciousness, she experienced diminution of vision, hallucinations, episodic irrelevant talking, myoclonic jerks, cortical blindness, and limb rigidity. The patient was reexamined within three months and was still mildly depressed and within nine months was back to normal.

Havaldar et al. (1990) reported on two female siblings who were admitted to the hospital after consuming an unknown quantity of endosulfan. The two year old experienced drowsiness, constricted pupils, and secretions in the chest and the nine month old experienced constricted

pupils. The younger child experienced several seizures. Both children recovered twenty-four hours later.

Blanco-Coronado et al. (1992) reported on six patients (three men and three women ranging in age from 20 to 53 years old) who ingested unknown quantities of endosulfan. One patient attempted suicide and was asymptomatic upon arrival at the hospital and the other five cases ate a cake that had been fixed with the chemical accidentally. All six cases experienced nausea, vomiting, headaches, dizziness, and convulsions about two and a half hours later. Five of the cases required mechanical ventilation and the sixth case experienced renal failure and died.

Tsai et al. (1988 meeting abstract) reported on fourteen cases (8 males and 6 females ranging in age from 12 to 57 years old) between March 1986 and March 1988 in Taiwan. The cases ingested between 50-500 ml of endosulfan (17.5-175 grams) and 93% of the cases were suicidal. Four patients died upon arrival at the hospital. Of the remainder, 9 cases experienced vomiting within 30 minutes, 6 developed profound hypotension, and 8 experienced tonic-clonic seizures which required mechanical ventilation.

Tiberin et al. (1969) reported on three industrial workers that were exposed daily to highly concentrated dusts due to the neglect of necessary precautions in their work area. They experienced convulsions, and loss of consciousness which occurred eighteen months, three weeks and one month later following daily exposures. They also exhibited EEG abnormalities. All three cases made a complete recovery after medical control was implemented and exposure was discontinued.

Garcia-Repetto et al. (1998) reported on 184 deaths from pesticide poisonings in Spain from 1991 to 1996. Ten of the cases occurred from exposure to mixtures including endosulfan. It was not possible to determine how many of the ten cases were primarily or solely due to the exposure to endosulfan because the identity of pesticides involved in mixtures was not specified.

Terziev et al. (1974) reported on two suicides and three accidental deaths that occurred two years earlier. The suicides involved an older man and woman who ingested up to 100 ml of endosulfan and died. In the accidental deaths, three young men took one or two sips from a liquor bottle that contained a brownish liquid. Two of the men died about one and a half hours later. The third accidental case spit the liquid out of his mouth, without swallowing the liquid, and washed out his mouth. An hour later, he experienced gagging, chest tightness, agitation, wide eyeballs, and a red face. He was released from the hospital several days later. A seventy year old woman accidentally ingested several drops for stomach pains and died about three hours later.

Chugh et al. (1998) reported 18 unintentional cases admitted to a hospital in India over a two year period. All of the cases exhibited nausea, vomiting, abdominal discomfort, and convulsions. Sixteen patients reported developing confusion, dizziness, or irritability prior to their convulsions. Twitching of the muscles, palpitation, and sweating were noted in 12 of the patients. All 18 cases were reportedly illiterate and did not use protective gloves or clothing. Other risk

factors reported in a majority of cases included preparing spray with bare hands, spray tank filled to brim with overflow, and lunch taken with unwashed hands.

Almost all of the literature reports involve suicidal or accidental ingestions. In the case reported by Terziev et al. (1974) it appears that one or two swallows were sufficient to cause fatality. Sood et al. (1994) reported on an accidental ingestion of 20 ml (concentration of endosulfan not reported) which was life-threatening. Only three reports, Aleksandrowicz et al. (1979), Tiberin et al. (1969), and Chugh et al. (1998) report on a total of 22 workers exposed by the inhalation and dermal routes. These workers appear to have been exposed to concentrates or significant levels as a result of flagrant disregard for rudimentary protective measures. These studies show that it is possible to experience convulsions and loss of consciousness from substantial occupational exposures. One animal study by Gilbert (1992) has shown that rats exposed repeatedly to levels below those that cause convulsions can become sensitized to future exposures and develop seizures after exposure to lower doses than would normally cause this effect. This may have bearing on the occupational cases that have been reported.

The following selected excerpts were taken directly for the Hazardous Substances Data Bank (HSDB). HSDB is a toxicology data file on the National Library of Medicine's Toxicology Data Network (TOXNET). Data are derived from "a core set of books, government documents, technical reports and selected primary journal literature. HSDB is peer-reviewed by the Scientific Review Panel (SRP), a committee of experts in the major subject areas within the bank's scope."

> A 70 yr old woman died about 3 hr after she had taken only "drops" of an endosulfan formulation for stomach pains ... the clinical picture ... involved gagging, vomiting, diarrhea, agitation, tonic clonic convulsions, foaming at the mouth, dyspnea, apnea, cyanosis, & loss of consciousness.
> [Hayes, Wayland J., Jr. Pesticides Studied in Man. Baltimore/London: Williams and Wilkins, 1982. 253]

> nine workers suffered one or more convulsions following exposure to endosulfan mainly in connection with bagging 50% water wettable powder. Five of the men were said to have used a respirator & protective clothing; two did not use a respirator, & the practices of the others were unknown. Six of the men had no history of a previous seizure, & no history of any sort was available for the others. In the only three of these cases described ... prodromal symptoms (malaise, vomiting, dizziness, weakness, or confusion) began while the man was at work & several hr before the first seizure, which sometimes occurred at home or on the street. At least in one instance, a convulsion was followed by unconsciousness lasting an hr; the seizure was so violent, that it resulted in fractures of the fourth & fifth dorsal vertebrae. One patient remained confused for about 24 hr & then recovered rapidly.
> [Hayes, Wayland J., Jr. Pesticides Studied in Man. Baltimore/London: Williams and Wilkins, 1982. 253]

> /in/ three cases ... associated with filling bags with freshly ground endosulfan powder ... the outstanding prodromal symptom was headache, & the initial sign was fainting. The fainting was associated with or followed by epileptoid twitching & foam at the mouth. One man bit his tongue, but apparently a full convulsion did not develop. EEG changes that promptly reverted to normal accompanied the illness. [Note: this appears to be the same incident reported by Tiberin et al. (1970) reported above.]
> [Hayes, Wayland J., Jr. Pesticides Studied in Man. Baltimore/London: Williams and Wilkins, 1982. 253]
>
> If spilled on clothing and allowed to remain may cause smarting and reddening of skin. [U.S. Coast Guard, Department of Transportation. CHRIS - Hazardous Chemical Data. Volume II. Washington, D.C.: U.S. Government Printing Office, 1984-5.]

VI. Conclusions

Most of the information from the Incident Data System and the scientific literature have limited value for interpreting the risks from proper use of endosulfan. The data from the Incident Data System often lacked information on the exposure circumstances but did indicate risk of poisoning from misuse and not wearing proper protective equipment. The scientific literature did show that workplace exposure to concentrated endosulfan could lead to serious, even life-threatening poisoning and, in one case, permanent neurological changes. However, it should be noted that all of these cases involved flagrant misuse (e.g., Chugh et al. 1998).

California data show a consistent risk of skin illness among field workers who come into substantial contact with foliage. Both handlers and field workers may experience moderate or systemic poisoning as a result of exposure to endosulfan. Endosulfan does not appear to pose significant risk from spray drift exposure.

VII. Recommendations

All exposed skin surfaces should be protected when workers are handling endosulfan. This is especially true for any worker handling concentrates. Special effort is warranted to keep concentrated endosulfan away from the lay public who may misuse it in a manner leading to life-threatening or fatal poisoning. Reentry periods to prevent substantial contact with treated foliage is warranted.

VIII. References

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Endosulfan file (chemical no. 079401)
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